INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

IYGL BULLETIN NO. 12

October 1974

INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

FYGL BULLETIN NO. 12

OCTOBER 1974

UNITED STATES

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DEPARTMENT OF DEFENSE

DEPARTMENT OF INTERIOR

DEPARTMENT OF TRANSPORTATION

ENVIRONMENTAL PROTECTION AGENCY

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CANADA

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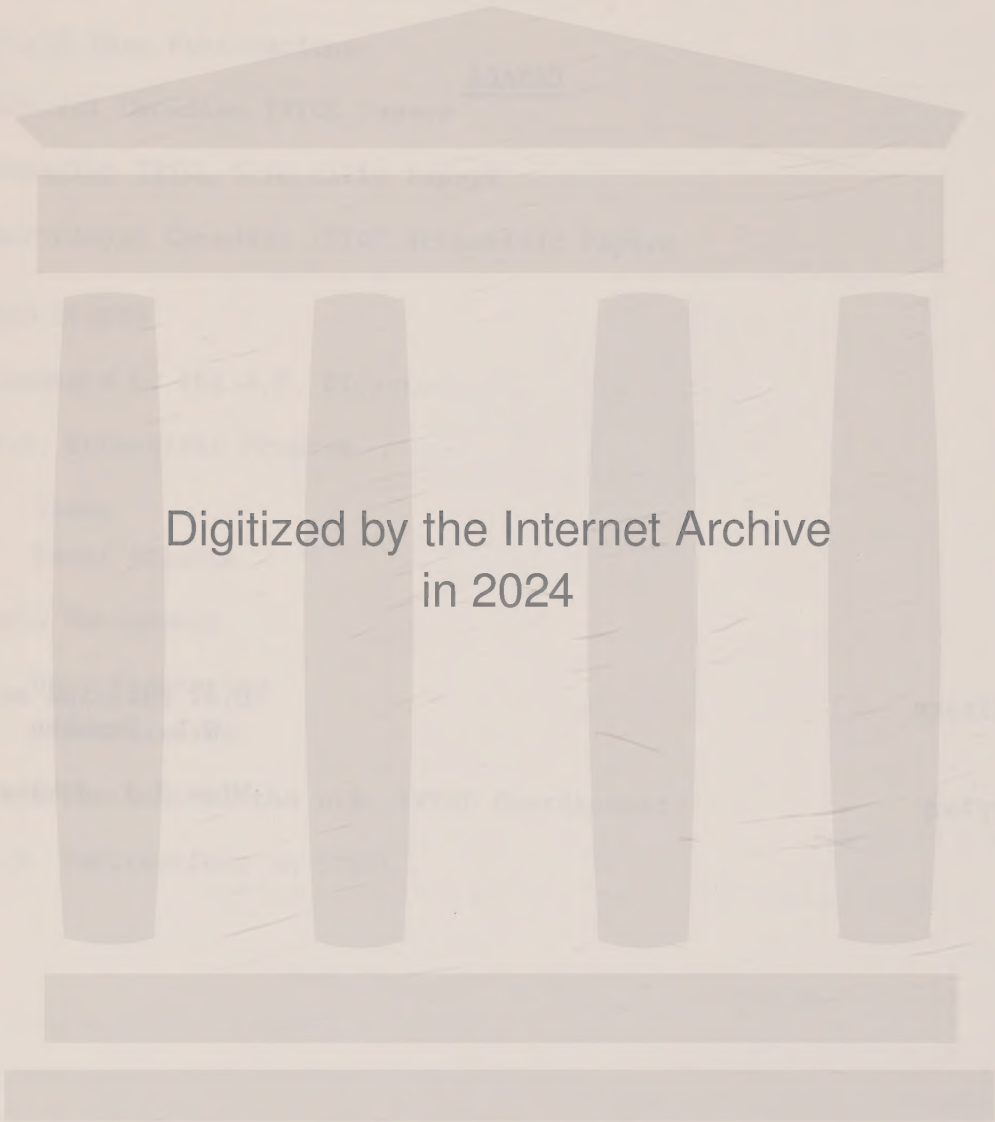

CANADIAN PROJECT REPORTS

Note: 1. Projects are numbered consecutively.

2. The letters following the number indicate which panel has prime responsibility for the project:

BC - Biological-Chemical
BL - Boundary Layer
EB - Energy Budget
ME - Lake Meteorology and Evaporation
TW - Terrestrial Water Balance
WM - Water Movement
F - Feasibility

Project

1F: *Remote Sensing*

Principal Investigator: K.P.B. Thompson - CCIW

This project is complete. See Bulletin #9.

3WM: *Statistical Prediction of Lake Currents*

Principal Investigator: H.S. Weiler - CCIW

This project has been cancelled effective July, 1974. There will be no material submitted to the IFYGL Data Bank.

4WM: included in Project 45WM *Lake Current Measurements.*

5BL: *Direct Measurement of Energy Fluxes*

Principal Investigator: M. Donelan - CCIW

This project is almost one-third complete and is expected to be finished at the end of 1975. The abstracts of papers entitled "Wind Stress from Water Set-up" and "Generalized Profiles of Wind Speed, Temperature, and Humidity", presented at the 17th Conference on Great Lakes Research are included in this edition of the IFYGL Bulletin.

8EB: *Shore-Gauging Stations of Water Temperature*

Principal Investigator: D.G. Robertson - CCIW

Near shore temperature data for seven stations is available. The final report is not completed, however, it should be finished December, 1974.

9EB: included in Project 42EB *Heat Storage of Lake Ontario*

11TW: *Monthly Water Balance of the Lake Ontario Basin*

Principal Investigator: D.F. Witherspoon - IWD Cornwall

This project is still in progress.

12TW: *Monthly Water Balance of Lake Ontario*

Principal Investigator: D.F. Witherspoon - IWD Cornwall

This project is now complete.

13TW: *Groundwater Flow into Lake Ontario*

Principal Investigator: E.A. MacDonald - DOE Hydrology

Completed.

14TW: *Hydrology of Lake Ontario*

Principal Investigator: E.A. MacDonald - DOE Hydrology

Completed see Bulletin #10.

15BL: *Space Spectra in the Free Atmosphere*

Principal Investigators: G.A. McBean and E.G. Morrissey - AES

Data analyses is still underway. Two papers have been submitted for the publication.

16ME: *Airborne Radiation Thermometer Survey*

Principal Investigator: J.G. Irbe - AES

Completed see Bulletin #9.

18ME: *Climatological Network*

Principal Investigator: J.A.W. McCulloch - AES

Completed.

19ME: included in Project 66ME.

20ME: *Bedford Tower Program*

Principal Investigator: J.A.W. McCulloch - AES

A software company has been commissioned to write the necessary program to convert from sensor output to scientific units and to apply calibration corrections. The program is expected to be written and tested by the end of October. Data will then be prepared for archiving at AES.

21ME: *Canadian Shoreline Network*

Principal Investigator: J.A.W. McCulloch - AES

Preliminary tape for first six months for all six stations will be submitted to Data Bank by the end of October. Some data missing from the tapes will be permanently lost, others will be recoverable with additional work. Data from the last six months will likely be available on some basis by the end of the calender year.

22ME: *Synoptic Studies*

Principal Investigators: J.A.W McCulloch and M.S. Webb - AES

Only preliminary work has been done p availability of meteorological data from Canadian shoreline ations, and U.S. tower, buoys and shoreline stations.

23ME: *Radar Precipitation*

Principal Investigator: D.M. Pollock - AES

Data for this project is presently being processed. No completion date can be given at this time.

24ME: *Climatological Studies*

Principal Investigator: D.W. Phillips - AES

Copies of "Climatological Weather Highlights during IFYGL" have been put on file at IFYGL Data Bank. Arrangements are being made to provide the IFYGL Data Bank with a complete set of six hourly weather charts on micro-film covering the IFYGL data period.

The abstract of the paper entitled "Climatological Weather Highlights" during IFYGL presented at the 17th Conference on Great Lakes Research is included in this edition of the Bulletin.

This project is now complete.

25ME: *Lake Ontario Evaporation by Mass Transfer*

Principal Investigator: J.G. Irbe - AES

Completed see Bulletin #9.

26ME: *Wind and Humidity Ratios*

Principal Investigator: M.S. Webb - AES

No further progress to report.

27ME: *Island Precipitation Network*

Principal Investigator: J.A.W. McCulloch

This data all has been published in "Supplementary Precipitation".

28BL: *Momentum, Heat, and Moisture Transfer*

Principal Investigators: G.A. McBean, H.C. Martin, R.J. Polavarapu - AES

Data analyses is almost complete.

29BL: *Space and Time Spectra*

Principal Investigators: F.B. Muller and C.D. Holtz - AES

Arrangements are being made to provide the IFYGL Data Bank with the data for the synoptic network. Additional data from the meso-scale network are held by the Principal Investigators.

30EB: *CCGS Porte Dauphine - IFYGL Operations*

Principal Investigator: G.K. Rodgers - CCIW

Completed.

32EB: *Thermal Bar Study*

Principal Investigator: G.K. Rodgers - CCIW

No further progress to report.

33EB: included in project 32EB *Thermal Bar Study*

34WM: *Circulation Near Toronto*

Principal Investigator: G.K. Rodgers - CCIW

No further progress to report.

36EB: *Electronic Bathythermograph*

Principal Investigator: G.K. Rodgers - CCIW

Completed.

38TW: *Groundwater*

Principal Investigator: R.C. Ostry - OME

No change in status of this proje

40WM: *Coastal Chain Study*

Principal Investigator: G.T. Csanady - University of terloo

Completed.

42EB: *Heat Storage of Lake Ontario*

Principal Investigator: F.M. Boyce - CCIW

Final reports on this project are being prepared.

43EB: *Internal Wave Measurements*

Principal Investigator: F.M. Boyce - CCIW

Nothing further to report. Final report may be available by the end of April, 1975.

44BL: *Analysis of Energy Fluxes*

Principal Investigator: F.C. Elder - CCIW

This project is now complete. An abstract of the paper presented at the 17th Conference on Great Lakes Research, entitled "Preliminary Energy Balance of Lake Ontario for the Period May through November 1972", is included in this edition of the Bulletin.

45BL: *Lake Current Measurements*

Principal Investigator: E.B. Bennett - CCIW

No progress report available.

46TW: *St. Lawrence-Niagara River Measuring Program*

Principal Investigator: E.A. MacDonald - DOE, IWD

No report available.

47TW: *Computer Modelling*

Principal Investigator: L.E. Jones - University of Toronto

No report available.

49TW: *Snow Stratigraphy and Distribution*

Principal Investigator: W.P. Adam - Trent University

No report available.

54BC: *Groundwater Supply near Kingston*

Principal Investigator: W.A. Gorman - Queens University

Completed.

55EB: included in 32EB:

62ME: *Evaporation Synthesis*

Principal Investigator: J.A.W. McCulloch - AES

Preliminary results were discussed in a paper presented at the 17th Conference on Great Lakes Research. The abstract of this paper is included in this edition of the Bulletin.

63EB: *Airborne Ice Reconnaissance*

Principal Investigator: T.B. Kilpatrick - AES

Completed.

64ME: *Basin Evapotranspiration*

Principal Investigator: H.L. Ferguson - AES

This project is expected to be completed by the end of this year. The abstract of a paper presented at the 17th Conference on Great Lakes Research giving a status report on the project is included in this issue of the Bulletin. The report covers a data period of October 30, 1972 to November 4, 1972.

65ME: *Special Shoreline Evaporation Pan Network*

Principal Investigator: J.A.W. McCulloch - AES

The United States office of Hydrology is now processing data.

66ME: *Atmospheric Water Balance Study*

Principal Investigator: H.L. Ferguson - AES

A paper presented at the 17th Conference on Great Lakes Research in August gave a progress report on this project. The abstract of this paper is included in this edition of the Bulletin.

67ME: *Atmospheric Water Balance Study*

Principal Investigator: M.S. Webb - AES

A status report on this project was given at the 17th Conference on Great Lakes Research. An abstract of this paper is included in this issue of the Bulletin.

68F: *CCIW Supporting Resources*

Principal Investigator: J.P. Bruce - CCIW.

Continues.

69TW: *Pleistocene Mapping*

Principal Investigator: E.P. Henderson - GSC

No report available.

70WM: *Ground Truth for Remote Sensing*

Principal Investigator: A. Falconer - University of Guelph

No report available.

71EB: *Canadian Radian Network*

Principal Investigator: J.A.W. McCulloch - AES

Completed.

72EB: *Floating Ice Research*

Principal Investigator: R.O. Ramseier - DOE, Ice

No report available.

73EB: *Terrestrial Heat Flow*

Principal Investigator: A. Judge - EM&R

No report available.

74TW: *Water Level Network*

Principal Investigator: G.C. Dohler

An extensive study of statistical prediction of storm surges on the Great Lakes including Lake Ontario has just been completed by Dr. Venkatesh. An internal manuscript report will be available early in the fall. Basically, atmospheric surface pressure and air-water temperature differences are used as predictors in a multi-linear regression scheme and a standard error of less than .235 feet is achieved.

Work on Helmholtz resonance in harbours and bays of the Great Lakes, specifically the Toronto Harbour which is a multi-channel harbour, has been pursued by Freeman, Murty and Hamblin and will be presented at the 17th Conference on Great Lakes Research. 1972 IFYGL data has been spectrally analysed and is being used to verify the Helmholtz resonant period for both the Toronto and Hamilton Harbours.

Dr. Paul Hamblin has completed an analytical model for the study of tides and natural oscillations in the Great Lakes. Donelan, Elder and Hamblin are investigating the estimation of wind stress from steady state water set-up of an enclosed water body, making use of the IFYGL water level data collected around the lake (paper 17th Conference on Great Lakes Research).

Dr. T.J. Simons is using IFYGL water level data to estimate the wind stress coefficients over water as derived from comparisons of observed and computed water levels over extended periods of time.

Finally, Andre Buldoc, who initiated this study, has produced a paper (for the 17th Conference on great Lakes Research) on storm surge simulation at Point Pelee, Lake Ontario, in which six different storm periods were studied and correlations of wind with water level difference obtained.

It is hoped that for the next bulletin a more detailed overview of all the work can be achieved, presenting some of the final results.

75BL: *Wind and Temperature Fluctuations*

Principal Investigators: A.D. Smith and E.C. Banks - Bedford Institute

Completed.

76WM: *Surface Wave Studies*

Principal Investigator: G.L. Holland - MSD

No additional information available at this time. The remaining task is to complete the publication of data which should be done within the next few months.

78TW: *Basin Water Balance*

Principal Investigator: M. Sanderson - University of Windsor

Data will not be processed until 1975.

79F: *Bathymetric Surveys of Lake Ontario*

Principal Investigator: T.D.W. McCulloch - CCIW

Completed.

80EB: *IFYGL Radiation Balance Program*

Principal Investigator: J.A. Davies - McMaster University

This project has been completed. All Canadian radiation measurements made during the Field Year have been reduced and the data, in final form, have been submitted to the Canadian IFYGL data bank.

Estimates of the lake surface radiation balance have been made on a daily basis for 13 zones. The procedures have been described in the project's final report (Davies and Schentzer, 1974). Radiation balance estimates compared favourably with lake tower measurements and with independent estimates of Atwater, Ball and Brown (1973).

Data for heat budget calculations have been derived from the balance estimates.

References

Atwater, M.A., J.T. Ball and P.S. Brown, 1973: The radiation budget of Ontario including cloud coverage: preliminary results. IFYGL Interim Report, The Centre for the Environment and Man, Hantford, Conn., 85 pp.

Davies, J.A. and W.M. Schentzer, 1974: Canadian radiation measurements and surface radiation balance estimates for Lake Ontario during IFYGL. Final Report, IFYGL Project Nos. 71EB and 80EB, Department of Geography, McMaster University, Hamilton, Ontario, 77 pp.

81BC: *Materials Balance - Lake Ontario*

Principal Investigator: S. Salbach - OME

A presentation in conjunction with D. Casey of the EPA, Rochester, was made August 14 at the Great Lakes Research Conference at McMaster University in Hamilton. The data collected by the OME and the EPA was compiled and analysed and the input and output loadings for chlorides, total nitrogen and total phosphorus were determined as parameters of interest in the materials balance. In all input considerations, the Niagara River was overwhelmingly predominant with all other sources being mainly of local significance only. A paper in connection with this presentation is expected to be published shortly and the municipal, industrial and tributary data obtained from the monitoring program has been sent to the Canadian Data Bank at CCIW in Burlington.

Sampling procedures and loading computations employed by the two different agencies provided an interesting point of comparison. One conclusion that was indicated by this comparison was that the difference in the result obtained from high frequency sampling programs as opposed to low frequency sampling programs increased directly with the variability of the flow of the river being monitored. In other words, for streams with relatively constant flow such as the Niagara and St. Lawrence rivers, a lower frequency sampling program appeared to be justified.

82BC: *Lake Ontario Zoo Plankton Migration*

Principal Investigator: J.C. Roff - University of Guelph

There is no further update available at this time on this project.

83BC: *Cooperative Studies of Fish Stocks*

Principal Investigator: W.J. Christie - OMNR

A general update of this project is contained in the AGU Symposium.

A sub-committee has been formed to organize and prepare the write-up on the relative abundance and distribution of near-shore fisheries of Lake Ontario. The numbers of the sub-committee are:

Dr. W.A. Hartman (USBFW - Sandusky)
Mr. G. LeTendre (N.Y. En. Con. - Cape Vincent)
Dr. D.A. Hurley (OMNR - Glenora)
Mr. S.J. Nepszy (OMNR - Wheatly)

The sub-committee has reported one productive meeting on July 9th and will meet irregularly to coordinate the compilation of U.S. and Canadian data. It is hoped that the entire phase I fisheries package will be in hand by March 1975.

84BC: *Cladophora Growth*

Principal Investigator: G.E. Owen - OME

No report available.

85BC: *Nutrient Cycles - Lake Ontario*

Principal Investigator: A. Frazer - CCIW

An introduction to a preliminary report entitled "Phosphorous and Nitrogen Cycle on a Transect in Lake Ontario" was contained in Bulletin #11. This paper was presented at the 17th Conference on Great Lakes Research. This project is partly finished.

86BC: *Lake Ontario Surface Chlorophyll Survey*

Principal Investigator: H.F. Nicholson - CCIW

The Canadian and U.S. chlorophyll data have now been amalgamated and a paper on the results is in preparation.

87EB: included in Project 42EB *Heat Storage of Lake Ontario*

89WM: *Turbulent Diffusion Studies*

Principal Investigator: C.R. Murty - CCIW

An extensive report entitled "Dispersion of Floatables in Lake Currents" is contained in Bulletin #11.

90WM: included in Project 89WM *Turbulent Diffusion Studies*

94 *Data Retransmission by Satellite*

Principal Investigator: H. MacPhail - CCIW

Completed.

95WM: *Hydrodynamic Modelling*

Principal Investigator: T.J. Simons - CCIW

A status report on this project is included in this edition of the Bulletin.

96WM: included in Project 45WM

97BL: *Meteorological Buoy Measurements*

Principal Investigator: F.C. Elder - CCIW

This project is now completed. All data has been reported to the data bank.

98BC: *Lake Ontario Cross-Section Study*

Principal Investigators: G. Carpenter and M. Munawar - CCIW

No report available.

101BC: *Lake Ontario Primary Production Study*

Principal Investigators: M. Munawar and J.E. Moore - CCIW

Lake Ontario Primary Production Studies has been finished and the following publication and presentation deal with this study.

1. Stadelmann P. and J.E. Moore, 1974.
   Measurement and Prediction of Primary Production at an Offshore Station in Lake Ontario.
   J. Fish. Re. Bd. of Canada Technical Report No. 445 available by CCIW Box 5050, Burlington, Ontario.

2. Stadelmann P., J.E. Moore and E. Pickett. 1974
   Primary Production in Relation to Light Conditions, Temperature Structure and Biomass Concentration at an Inshore and Offshore Station in Lake Ontario.
   J. Fish. Re. Bd. of Canada. July volume in press.

3. Vollenweider R.A., M. Munawar and P. Stadelmann. 1974.
   A Comparative Review of Phytoplankton and Primary Production in the Laurentian Great Lakes.
   Limnology in Canada: special issue of J. Fish. Re. Bd. Canada. Volume in press.

4. Stadelmann P. and M. Munawar. 1974
   Biomass Parameters and Primary Production at a Near-Shore and Mid-Lake Station of Lake Ontario during IFYGL.
   Presented at the Great Lakes Conference 1974.

102BC: *Lake Ontario Diel Pigment Variation*

Principal Investigators: W. Glooschenko and M. Munawar - CCIW

This project is now complete. The final paper "Short Term Variability of Chlorophyll A Concentrations in Lake Ontario" was presented at the 17th Conference of Great Lakes Research. The abstract of this paper is included in this edition of the Bulletin.

103BC: *Pesticide Concentration in Bird's Eggs*

Principal Investigator: M. Gilbertson - CWS

No report.

104BC: *Rain Quality Monitoring*

Principal Investigator: M. Shiomi - CCIW

Additional data still being collected.

107BL: *Air Pollution Sinks*

Principal Investigator: D.M. Whelpdale - AES

No report available.

108BL: *Lake Level Transfer*

Principal Investigator: G.C. Dohler - MSD

Completed.

109WM: *Upwelling Study*

Principal Investigator: G.K. Rodgers - CCIW

No further progress to report at this time.

110WM: *Hydro Intake Study*

Principal Investigator: A. Arajs - OH

Completed.

111WM: *Lakeview Dispersion Study*

Principal Investigator: M.D. Palmer - OME

No report available.

112BC: *Threespine Stickleback*

Principal Investigator: E.T. Garside - Dalhousie University

No report available.

114WM: included in Project 89WM.

115WM: *Wave Climatology*

Principal Investigator: H.K. Cho - CCIW

No report available.

116TW: *Airborne Gamma Ray Snow Survey*

Principal Investigator: H.S. Loijens - IWD Glaciology

No report available.

117ME: *APT Photographs*

Principal Investigator: J.A.W. McCulloch - AES

This project is now completed. The microfilm is on file at the IFYGL Data Bank. Second copy sent to U.S. Data Bank.

118 *Canadian IFYGL Data Bank*

Principal Investigator: J. Byron - CCIW

Cat. No.	3-118-018	IFYGL Bulletin #10
Cat. No.	3-118-019	Technical Manual Series #5: U.S. IFYGL Shipboard Data Acquisition System
Cat. No.	3-118-020	Technical Manual Series #1: Methods of Measuring Soil Moisture
Cat. No.	3-118-021	Technical Manual Series #2: Radiation Measurement
Cat. No.	3-118-022	Canadian Projects
Cat. No.	3-118-023	Canadian Projects - Supplement 1
Cat. No.	3-118-024	Canadian Projects - Supplement 2
Cat. No.	3-118-025	Canadian Projects - Supplement 3
Cat. No.	3-118-026	Canadian Projects - Supplement 4
Cat. No.	3-118-027	Technical Manual Series #4: U.S. IFYGL Precipitation Data Acquisition System
Cat. No.	3-118-028	Technical Manual Series #3: Measurement of Currents in the Great Lakes

ABSTRACTS OF IFYGL PAPERS

WIND STRESS FROM WATER SET-UP. M.A. Donelan, F.C. Elder and P.F. Hamblin, Canada Centre for Inland Waters, Burlington, Ontario

(IFYGL Project 5BL)

The estimation of wind stress from the steady state water set-up of an enclosed water body is fraught with uncertainties arising primarily from measurement errors of the overall wind field and the water level in the presence of shoaling waves. During the IFYGL there were several accurate water level recording gauges installed around Lake Ontario, and the wind field was monitored continuously at a score of stations across the Lake. In addition, a "deep water" gauge was installed off Niagara-on-the-Lake. This gauge is compared with nearby gauges in shallower water to assess the effect of wave set-up on the water level measurements in shallower water. The results are used to adjust the measurements of the shallow water gauges and thereby to obtain water slopes which are compared with the surface wind field. Drag coefficients are computed and compared with those derived from recent eddy correlation measurements.

CLIMATOLOGICAL WEATHER HIGHLIGHTS DURING IFYGL. D.W. Phillips, Department of Environment, Atmospheric Environment Service, Toronto, Canada.

(IFYGL Project 24ME)

One of the principal goals of IFYGL Project 24 ME, Climatological Studies is to assist principal investigators by comparing monthly averages of various meteorological variables during the data-gathering period with normals computed from the 1941-1970 period. Before data interpretation and model testing begin or before results are extrapolated elsewhere, conditions under which the scientific data were collected should be known.

The land portion of the Lake Ontario basin is well endowed with almost 200 climatological stations (July 1972) at which both air temperature and precipitation are observed. An additional 60 stations report only precipitation amounts and/or intensity. With a density of one gauge per 100 square miles, the basin has one of the densest climatological networks in North America. The distribution of climatological stations is relatively uniform with only one area devoid of sampling, near Bancroft, Ontario. The number of stations with special instrumentation, such as evaporation pans, anemometers and sunshine recorders, is well above the density recommended for meteorological services by the World Meteorological Organization. Climatological sampling over Lake Ontario is almost non-existent. There are no full-time permanent installations, only a partial program at Toronto Island and a seasonal operation at Main Duck Island.

The weather during the data-gathering period of IFYGL could be described as cold, stormy and dull. The mean annual temperature was within one degree of normal; however, five months had temperatures between one and three

standard deviations. The period was also one of almost continuous, heavy precipitation and frequent flooding. Total precipitation from April 1972 to March 1973 varied from 32 inches north of Toronto to 64 inches in the Adirondacks, averaging about 7.0 inches greater than normal. An indication of how wet and dull the year was, is evident by the fact that every month had an above normal number of days with precipitation, for an annual total of 45 rain days more than usual. The number of hours of sunshine was almost 200 hours fewer than normal (90 percent).

To best summarize the weather across the basin, where wide regional differences are common, climatological data from 20 representative stations were collected to produce basin-wide averages. Table 1 lists monthly means for a number of elements during the IFYGL compared with normal values, usually the 30-year period from 1941 to 1970.

The outstanding weather event of the field year was the torrential rains and widespread flooding caused by Hurricane Agnes. Rains totalling more than a foot fell in parts of the basin from the evening of June 20th until the morning of the 25th. For most of the Ontario side five day totals ranged from two to three inches. Most of the land south of the lake experienced rainfalls above four inches with local amounts to 13 inches. Torrential rains on soils already saturated with heavy spring precipitation and snow melt resulted in rapid runoff causing local flash flooding in a number of counties in the Finger Lakes district.

Other record-breaking weather events along with conditions during the six IFYGL alert periods are described through maps, tables and pictures.

Deviations from Normal (1941-1970) for
a Number of Meteorological Variables on a Basin-Wide Basis

	April	May	June	July	August	Sept.
Mean Temperature (^{o}F)	-5.9	2.1	-2.8	-0.3	-1.5	0.5
Precipitation	-0.50	0.64	3.55	-0.17	0.27	0.08
Snowfall (in)	3.1					
Solar Radiation (ly day^{-1})	23	27	-90	-26	-43	-16
Sunshine (hr)	36	23	-85	-17	-21	-4
Precipitation Days (#)	1	2	6	3	5	2
Wind Speed (mph)	-0.9	-1.4	0.0	-0.7	-0.4	0.0

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Year
Mean Temperature (^{o}F)	-6.0	-3.9	1.8	4.4	-2.8	8.9	0.5
Precipitation (in)	0.54	1.05	1.61	-0.45	-0.32	0.79	7.0
Snowfall (in)	0.5	2.5	8.7	-6.4	-5.1	-8.1	-5.0

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Year
Solar Radiation (ly day^{-1})	-38	-33	-27	-9	1	-78	
Sunshine (hr)	-37	-23	-40	29	22	-42	-159
Precipitation Days (#)	5	3	10	0	3	5	45
Wind Speed (mph)	0.0	-1.2	-0.2	1.5	-0.9	0.0	-0.3

PRELIMINARY ENERGY BALANCE OF LAKE ONTARIO FOR THE PERIOD MAY THROUGH NOVEMBER 1972. F.C. Elder and F.M. Boyce, Canada Centre for Inland Waters and J.A. Davies, McMaster University, Hamilton, Ontario

(IFYGL Project 44BL)

Measurement programs of the International Field Year on the Great Lakes have provided information from which the heat storage, radiation balance, and surface heat fluxes can be calculated on a weekly or bi-weekly basis. The meteorological buoy network operated over only the period May through November so that the preliminary estimates of the surface heat fluxes are limited to that period. Radiation balance estimates have been calculated on a daily basis but the heat content estimates are obtained from ship surveys at weekly or bi-weekly intervals.

Heat storage, radiation balance, and surface heat fluxes have been calculated for each of thirteen sections and for Lake Ontario as a whole for each period determined by the ship surveys. Because all of the meteorological data from IFYGL have not been available, these estimates must be considered preliminary. The available data do, however, constitute more overwater measurements than have been available for such estimates in prior studies and should constitute a significant sample of lake-modified airmass.

While the year-long energy balance is not as yet calculated, the preliminary estimates for the period of buoy exposure gives an evaluation of the weekly variations in each of the budget terms and permits assessment of the relative imbalance on a short period basis. Values for each of the energy budget terms and of their time variations are presented together with an evaluation of the total energy balance for the period from May through November which includes a portion of both the warming and cooling cycles.

PRELIMINARY EVAPORATION ESTIMATES BY MASS-TRANSFER FROM LAKE ONTARIO DURING IFYGL. J.A.W. McCulloch, Atmospheric Environment Service, Downsview, Ontario

(IFYGL Bulletin 62ME)

The Atmospheric Environment Service has used an empirical modification of the Lake Hefner/Lake Mead mass transfer equation to estimate evaporation from the Great Lakes. Monthly mean data from stations surrounding the lakes are adjusted using the work of Richards and his colleagues to represent overwater conditions. The weaknesses of the approach have long been recognized,

but IFYGL will provide the first opportunity to make significant improvements. The "Evaporation Synthesis" task should lead to such results.

For each month of IFYGL, evaporation from Lake Ontario was estimated by the traditional mass-transfer approach. Because of the greater availability of surface-water temperature data, it was thought feasible to attempt daily estimates as well. The technique was modified to reflect the changed nature of the data. In this paper, the details of the procedure are presented.

While individual daily values may not have acceptable absolute accuracy because of the problems remaining, it is interesting to note the apparent day-to-day variations and compare the sum for the month with estimates obtained in other ways. Preliminary monthly estimates have been provided both by the Terrestrial Water Budget Panel, and by Floyd Elder (from flux calculations based on Canadian buoy data). The agreement is surprisingly good for the high-evaporation months, but the discrepancies during the spring are appreciable.

THE ATMOSPHERIC BUDGETS PROGRAM OF IFYGL.

E.M. Rasmusson[1], H.L. Ferguson[2], J. Sullivan[1] and G. den Hartog[2]

1. National Oceanic and Atmospheric Administration, CEDDA, Washington, D.C.
2. Environment Canada, Atmospheric Environment Service, Toronto, Ontario.

(IFYGL Project 64ME)

The water vapor and heat budgets of the atmosphere over Lake Ontario will be evaluated to obtain estimates of average lake evaporation for periods on the order of a week. Data for this project were obtained during September-December 1972 from a 6-station network of LORAN-C rawinsonde stations located along the perimeter of the lake.

The design of the experiment and results of the field program are reviewed. Unexpected errors in the LORAN-C time delay data required a significant sacrifice of vertical resolution in the processed wind data. However the relatively high time and vertical resolution of the temperature and humidity data reveal the detailed structure of these fields to a degree not attainable with routine operational data.

A set of conservation equations, suitable for budget analyses over Lake Ontario, is derived. Special attention is given to the possibility of phase changes between liquid, solid, and vapor states, and problems arising when the flux of condensed moisture across the shoreline is significant.

A budget analysis scheme is discussed in which the meteorological fields are represented in terms of a set or orthogonal functions in time and space. Examples of fitted wind and humidity field are presented.

MONTHLY EVAPOTRANSPIRATION ESTIMATES FOR THE CANADIAN LAND PORTION OF THE LAKE ONTARIO BASIN DURING THE IFYGL

H.L. Ferguson and W.D. Hogg. Atmospheric Environment Service, Toronto, Ontario

(IFYGL Project 66ME)

A grid-square technique for calculating monthly evapotranspiration was developed by the Hydrometeorology and Environmental Impact Research Division of AES in 1972 and tested in the Okanagan Basin of British Columbia. This method has been adapted to the Canadian land portion of the Lake Ontario Basin.

The first step in the analysis is the tabulation of selected cover and physiographic characteristics for 136 grid areas of 400km^2. Next, regression equations are obtained relating longer-term mean climatological data to cover and physiography. Grid area mean monthly values of precipitation, temperature and "lake evaporation" (based on Class A pan network data) are then tabulated.

Ratios of mean monthly evapotranspiration to mean lake evaporation, for various cover types, are postualted, based on other studies. Grid square values of mean monthly evapotranspiration are obtained. Iteration and optimization techniques can be applied to obtain "best fit" fields of mean evapotranspiration and precipitation, consistent with mean run-off.

Individual months of the International Field Year on the Great Lakes are then analyzed. Grid values of monthly "deviations from normal" for the water balance variables are generated. The deviation fields are added to the normal fields to obtain monthly grid-area values of the water balance variables. These data can be used to generate monthly maps of "lake evaporation", actual evapotranspiration, and other variables of interest. Results are compared at selected locations to estimates of evaporation obtained from the Thornthwaite and Penman methods.

Innovations in the model include the application of rational relationships between cover (and physiographical) characteristics and the individual fields of mean precipitation and mean evapotranspir In addition, provision is made in the model for adjusting precip for rainfall and snowfall undercatch to optimize the water balance.

Implications of precipitation undercatch in the calculation of evapotranspiration or evaporation by other techniques are discussed. Suggestions are made for further refinements of the model.

MEAN SURFACE TEMPERATURES OF LAKE ONTARIO DURING THE IFYGL

Michael S. Webb, Atmospheric Environment Service, Environment Canada Downsview, Ontario

(IFYGL Project 67ME)

As part of the contribution to the International Field Year for the Great Lakes (IFYGL) by the Atmospheric Environment Service of Environment

Canada, the surface temperature of Lake Ontario was surveyed on 47 occasions between April, 1972, and March, 1973, inclusive, using an airborne radiation thermometer (ART). For each of 91 grid-points on the lake, a surface temperature was abstracted from each ART survey map, plotted against date, and a mean value estimated for each month. These monthly values were then used to determine the average temperature of the entire lake for each month of the Field Year. Table 1 shows these average monthly temperatures (^{o}C), along with the corresponding "normal" which is based on six years of ART data (1966-1971).

Table 1

	A	M	J	J	A	S
Normal (1966-1971)	2.1	4.1	10.0	18.1	19.8	17.5
IFYGL	1.4	4.6	8.1	16.0	18.5	17.9
	O	N	D	J	F	M
Normal (1966-1971)	13.2	8.2	4.3	2.7	1.5	1.2
IFYGL	11.2	7.0	4.2	2.5	1.4	1.4

From this table, it can be seen that the greatest positive anomaly of any IFYGL month was only a half degree, while on three occasions, negative anomalies of about two degrees occurred.

Maps will be presented which will show the distribution of the mean surface temperature of Lake Ontario for the months April, 1972, through March, 1973, and thus of the heat content of the surface waters. Definite temperature patterns will be seen. The presence of the Niagara River effluent is of particular interest, as is the appearance of cold water off the northwest shore in August.

In general, though, a close resemblance exists between these IFYGL maps and the normal ones. Since only one year of data was used to prepare these maps, this similarity is particularly significant. It implies that much of the detail which appears on many temperature survey maps must represent fluctuations about a mean. This mean would be governed by lake morphometry and climate.

SHORT-TERM VARIABILITY OF CHLOROPHYLL A CONCENTRATIONS IN LAKE ONTARIO

W.A. Glooschenko and J.O. Blanton, Lakes Research Division, Canada Centre for Inland Waters, Burlington, Ontario

(IFYGL Project 102BC)

Research on both marine and freshwater systems has shown the presence of diel (24 hour) variations of chlorophyll a. In general, lower values of this pigment have been found during periods of highest incoming solar radiation, and bleaching of chlorophyll at these high light intensities has been attributed as the cause of this phenomenon. In order to examine this phenomenon in the Great Lakes, an IFYGL program was set up in which eight

cruises were made roughly monthly, between April 1972 and 1973. Two Lake Ontario Stations were chosen, one inshore near Oshawa, Ontario and the other mid-lake. Chlorophyll a samples were taken approximately every two hours at depths of 1, 5 and 10 m on the inshore station and 1, 10 and 20 m in the mid-lake station. However, a 0-10 m integrating sampler was used during the November 1972, January and March 1973 cruises.

Reduction of 1 m chlorophyll a concentrations during periods of high light intensities was observed during the late June and July cruises on the nearshore station only. This was probably related to the fact that during most cruises, light intensities were too low to produce this effect. However, variability of chlorophyll a concentrations as great as 100% occurred at the lower depths sampled during periods when the thermocline was well developed. This variability was correlated with a thermocline motion in which the fixed depths sampled moved from the epilimnion into the thermocline to the hypolimnion and back again over the sampling period. A periodicity of 14 to 17 hours was observed in chlorophyll a concentrations, related to internal seiches induced by the earth's rotation.

When the lake was not thermally stratified, variability of chlorophyll a concentrations was observed with coefficients of variation between 20-30%. Patchiness of phytoplankton, especially horizontal, probably account for this observation. Horizontal advection by currents, vertical turbulence, and presence of Langmuir cells, are possible mechanisms causing such patchiness.

In light of these observations, caution must be used in interpreting spatial and temporal distributions of chlorophyll a in lakes. Special care must be made to avoid sampling in the regions near the thermocline due to motions that take place. For this reason, epilimnion samples during periods of thermal stratification are recommended as opposed to fixed depth or integrated samples which could be affected by thermocline motions.

HYDRODYNAMICAL MODELLING - Final Report. T.J. Simons Physical Limnology Section, Canada Centre for Inland Waters Burlington, Ontario

(IFYGL Project 95WM)

In conjunction with the International Field Year on Lake Ontario, the Canada Centre for Inland Waters initiated a comprehensive modelling programme with the goal of simulating water levels, currents, temperatures, and the transport of dissolved or suspended materials in the Great Lakes. This modelling project was carried out in two phases. The first part was concerned with a systematic investigation and scrutiny of numerical techniques employed in the field of geophysical fluid dynamics and the development of a hierarchy of models describing the circulation of large lakes under various conditions. Particular attention was paid also to simulations of the effects of hydrodynamic circulations on the distribution of water quality parameters. This model development and preliminary computations were described in three papers by the author (Simons, 1971, 1972, 1973a).

The second phase of the modelling programme consisted of a verification study based on the abundance of observational data produced by IFYGL. In particular, two significant events were singled out during which the lake was subjected to strong atmospheric forcing. The first of these episodes was associated with tropical storm Agnes during the second half of June, 1972, when the lake was only weakly stratified. The second episode occurred in early August at the peak of the lake's stratification. The detailed procedures and results of these varification studies have been presented elsewhere (Simons, 1973b, 1974, 1975). Complete descriptive summaries of the two storm episodes are also available (Staff CCIW, 1973a, 1973b).

After the above verification studies were completed, the model was used to compute the three-dimensional water circulations of Lake Ontario throughout the Field Year. The output stored on magnetic tape consists of currents and temperature on a grid-spacing of 5 km and at four depths corresponding to the positions of IFYGL current meters. A report on the salient features of these computations and their application to ecological model studies is in pre preparation. A more detailed review of the present IFYGL project is available under the title "IFYGL Hydrodynamical Modelling Studies at CCIW" and can be obtained by writing to the Author (T.J. Simons, Canada Centre for Inland Waters, P.O. Box 5050, Burlington, Ontario).

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GENERALIZED PROFILES OF WIND SPEED, TEMPERATURE AND HUMIDITY.

M.A. Donelan, D.N. Birch, and D.C. Beesley,
Canada Centre for Inland Waters, Burlington, Ontario.

(IFYGL Project 5BL)

Throughout the four boundary layer active periods of the IFYGL ten minute averaged profiles were measured from a tower off Niagara-on-the-Lake. This paper describes the measurement system and summarizes the profiles by a set of non-dimensional functions of stability which would allow one to contruct profiles knowing only the air-water differences of the three primary stability determining parameters: wind speed, temperature and humidity.

FIELD YEAR PUBLICATIONS

1. IFYGL Bulletins No.'s 1-11

2. IFYGL Technical Plans, Volumes 1-4

3. IFYGL Canadian Projects, March 1972

   Canadian Projects Supplement #1 - July 1972
   " " " #2 - October 1972
   " " " #3 - February 1973
   " " " #4 - June 1973

4. IFYGL Technical Manual Series

   #1 Methods of Measuring Soil Moisture - R.G. Wilson
   #2 Radiation Measurement - J. Ronald Latimer
   #3 Measurement of Currents in the Great Lakes - M.D. Palmer
   #4 U.S. IFYGL Precipitation Data Acquisition System - A.L. Hansen, J.W. Wilson, C.F. Jenkins, L.A. Weaver
   #5 U.S. IFYGL Shipboard Data Acquisition System - A. Robertson.

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UNITED STATES

Editors — Fred Jenkins and May Laughrun

Typing — Robert E. Massey

COMMENTS BY THE U.S. DIRECTOR

The U.S. IFYGL Project Office, a part of the Great Lakes Research Laboratory, has been relocated in Ann Arbor, Mich. The new address, as given in IFYGL Bulletin No. 11, is

U.S. IFYGL Project Office
Great Lakes Environmental
Research Laboratory
2300 Washtenaw Avenue
Ann Arbor, Mich. 48104

Our new telephone number is (313) 769-7100, Ext. 254, FTS (313) 769-7254.

This issue covers the progress of IFYGL tasks for April 1 through June 30, 1974 (fig. 1). Reports on some later activities are also included, particularly as they pertain to data management.

The following data sets are now available:

- o The PDCS Provisional Data Base
- o All rawinsonde data.

The Proceedings, IFYGL Symposium, Fifty-fifth Annual Meeting of the American Geophysical Union, April 8-12, 1974 is in press. Some 63 papers on IFYGL were accepted for presentation at the Seventeenth Conference on Great Lakes Research at McMaster University, Hamilton, Ontario, August 12-14, 1974. At the last meeting of the Joint Management Team, agreement was reached that papers accepted for publication will appear in a separate volume of the Conference Proceedings.

Two technical manuals are still in preparation: one on the Physical Data Collection System (PDCS), the other on the rawinsonde data collection system. Planning for the IFYGL Scientific Report series is continuing.

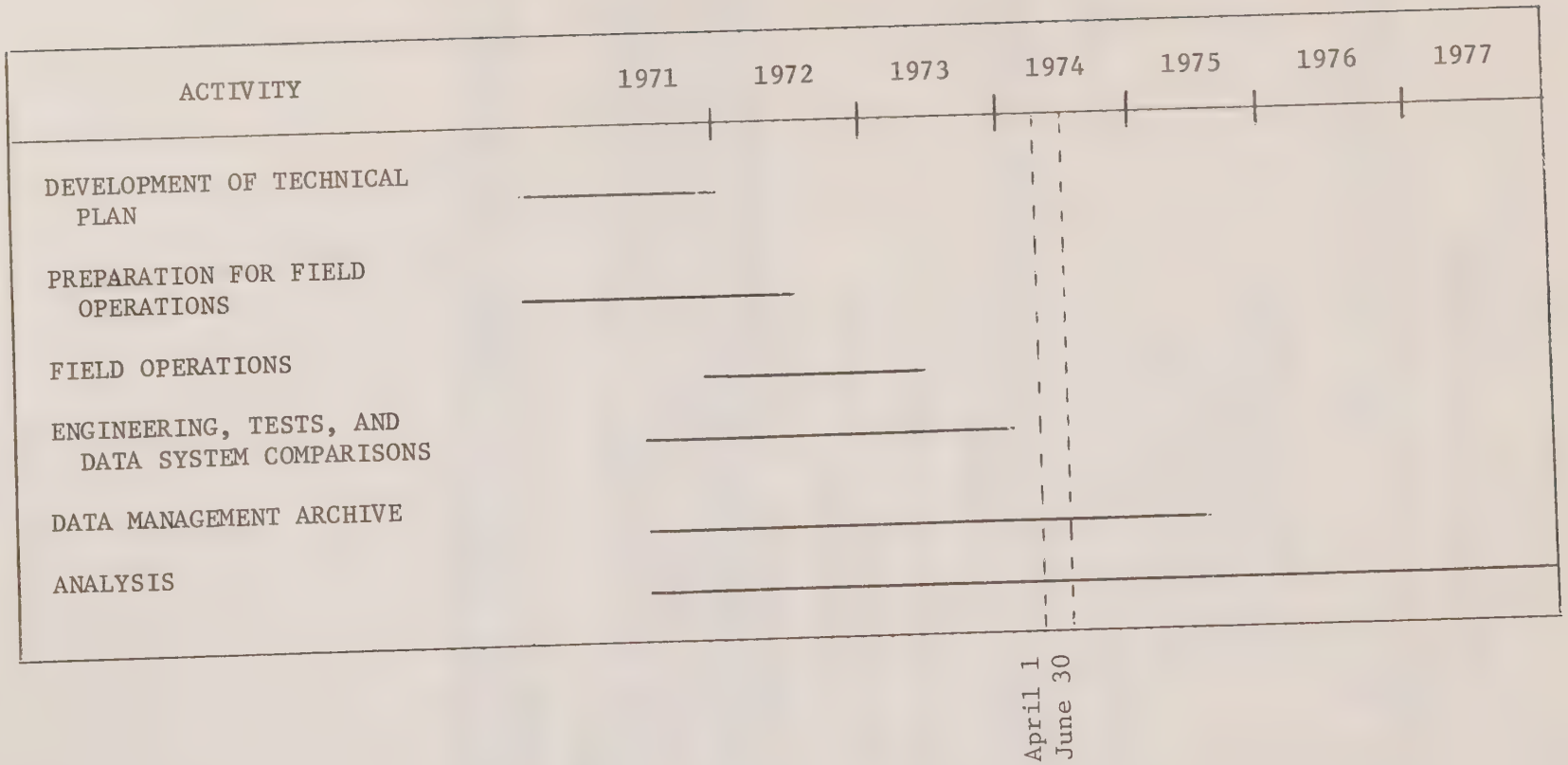

Figure 1.--U.S. IFYGL schedule.

U.S. SCIENTIFIC PROGRAM

Based upon reports requested by the U.S. IFYGL Project Office, the progress from April 1 through June 30, 1974, is presented for each of the U.S. IFYGL tasks. Some reports cover work done in July 1974.

Panel activity status reports follow the task reports.

Tasks

1. *Phosphorus Release and Uptake by Lake Ontario Sediments*

Principal Investigators: D.E. Armstrong and R.F. Harris - University of Wisconsin

Evaluation of experimental results in preparation for publication was almost completed. The proportion of potentially mobile (NaOH-P) inorganic P was usually high (30 to 60 percent) in the central basin sediments, and low (2 to 8 percent) in the inshore zone sediments. Interstitial inorganic (mobile) P concentrations ranged from 14 to 1,280 µg/1 and were higher than dissolved inorganic P concentrations in the overlying water. Based on an inorganic P flux of 0.2 mg m^{-2} day^{-1} for P released from incubated intact sediment cores, the estimated annual contribution of inorganic P to Lake Ontario water is equal to about 10 percent of the external P loading.

2. *Net Radiation*

Principal Investigator: M.A. Atwater - CEM

The computer program is essentially complete and has been modified to include data from studies of fog over Lake Ontario in the spring of 1973 and of clouds above extensive lower cloud layers. The inclusion should improve the accuracy of the computed downward radiation fluxes, which can easily be compared with radiative fluxes observed at fixed sites or on moving ships.

Plans for the next quarter include: comparison of observed and computed fluxes at several locations, computation of radiative heating rates and of radiative fluxes over the lake, preparation of a final contract report, and presentation of two papers at the Seventeenth Conference on Great Lakes Research.

3. *RFF/DC-6 Boundary Layer Fluxes*

Principal Investigator: B.R. Bean - ERL/NOAA

A draft copy of the final report on this task has been prepared.

4. *Nitrogen Fixation*

Principal Investigator: R. Burris - University of Wisconsin

Task completed.

5. *Profile Mast and Tower Program*

Principal Investigator: J.A. Businger - University of Washington

No report.

6. *Status of Lake Ontario Fish Populations*

Principal Investigator: J.H. Kutkuhn - Great Lakes Fisheries Laboratory

No report.

7. *Material Balance of Lake Ontario*

Principal Investigator: D.J. Casey - EPA

No report.

8. *Runoff*

Principal Investigator: L.T. Schutze - U.S. Army Corps of Engineers

Work completed.

9. *Evaporation (Lake-Land)*

Principal Investigator: L.T. Schutze - U.S. Army Corps of Engineers

First-cut estimates for the Field Year have been completed. Final estimates will be made when data for other terms of the lake equation are received.

10. *Simulation Studies and Analyses Associated With the Terrestrial Water Balance*

Principal Investigator: B.G. DeCooke - U.S. Army Corps of Engineers

Activity has not begun.

11. *Land Precipitation Data Analysis*

Principal Investigators: L.T. Schutze and R. Wilshaw - U.S. Army Corps of Engineers

No progress was made in this quarter. Plans are to investigate methods of estimating weekly and monthly precipitation based on readily available daily data and estimates from index stations.

12. *Transport Processes Within the Rochester Embayment of Lake Ontario*

Principal Investigator: W.H. Diment - University of Rochester

No report.

13. *Soil Moisture and Snow Hydrology*

Principal Investigator: W.N. Embree - U.S. Geological Survey

Work has consisted of preparing a draft report for final review and approval.

14. *Boundary Layer Structure and Mesoscale Circulation*

Principal Investigator: M.A. Estoque - University of Miami

See Task 15 below.

15. *Mesoscale Simulation Studies*

Principal Investigator: M.A. Estoque - University of Miami

Progress has been made in numerical simulations, especially with the two-dimensional model. Wind, temperature, and moisture distributions have been determined by simulating a 1 p.m. lake breeze.

16. *Lake Level Transfer Across Large Lake*

Principal Investigator: C.B. Feldscher - LSC/NOAA

No report.

17. *Nearshore Ice Formation, Growth, and Decay*

Principal Investigators: A. Pavlak and J. Dilley - General Electric Company

We have added to the transient heat conduction model the capability of (1) computing the moving phase front, and (2) handling intermaterial boundaries, such as the lake bottom. Inclusion of the surface heat transfer will complete requirements for converting a transient heat temperature model to an environmental model.

The surface heat transfer consists of evaporation, convection, and radiation. Windspeed data from IFYGL station 29 in Oswego, air temperature at 2 m, and relative humidity derived from dewpoint temperature were used in determining evaporation and convection. The radiative heat transfer has four components: (1) incoming solar, (2) reflected solar, (3) downward thermal (for wavelengths greater than 4 μ), and (4) reradiated thermal radiation.

For input to the model, the first three were taken from the model output provided by M. Atwater and based on data obtained at the Oswego meteorological station. In the computation of the reradiated thermal radiation, $\varepsilon\sigma T_s^4$ was used, where ε = emissivity, σ = a constant, and T_s = surface temperature.

18. *Advection Term - Energy Balance*

Principal Investigator: J. Grumblatt - GLERL/NOAA[1]

Calibration data for the water temperature recorders at Lewiston, Cape Vincent, and Clayton, N.Y., have been reviewed, and the final hourly mean water temperature data from the monitoring stations have been loaded on computer disc pack. Computer printouts have been generated, showing (a) the monthly average diurnal temperature curves, and (b) tabulated frequency distribution of daily average water temperature by month. Daily mean heat flow in the lower Niagara River has been calculated for May 1972 through December 1973. Factors affecting water temperature at Cape Vincent and Clayton, N.Y., are being analyzed to determine the best method for computing the daily mean temperature of Lake Ontario outflow into the St. Lawrence River.

19. *Occurrence and Transport of Nutrients and Hazardous Polluting Substances in the Genesee River Basin*

Principal Investigator: L.J. Hetling - New York State Department of Environmental Conservation

The final report is being prepared.

20. *Boundary Layer Flux Synthesis*

Principal Investigators: J.A. Almazan and J.K.S. Ching - CEDDA/NOAA

The orthogonal function objective analysis technique, reported on in IFYGL Bulletin No. 9, has been applied to the meteorological data from the United States and Canadian buoys and towers for July 8 to 21, 1972. These spatial analyses include air temperature, lake surface temperature, windspeed, wind components, and specific humidity fields. Daily lake averages were computed. The technique was also applied successfully to obtain estimates of the surface fluxes of momentum, heat, and moisture, and daily "fields" of these estimates were computed.

Comparison of meteorological data for July 8 to 21, 1972, from the two adjacent United States and Canadian buoys has been completed, and comparison of the October 1972 is in progress.

Plans for the next quarter are to (1) apply the objective analysis technique to buoy data obtained during an unstable period, e.g., October 1972; (2) further develop the technique of computing diurnal variations; and

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[1] Affiliation changed to Great Lakes Environmental Research Laboratory (GLERL), NOAA, Ann Arbor, Mich.

(3) combine the results of the lake-land breeze studies reported in IFYGL Bulletin No. 8 with the divergence and vorticity "fields" computed by the objective analysis scheme for July 1972. Two papers dealing with these studies will be presented at the Seventeenth Conference on Great Lakes Research.

21. *Hazardous Material Flow*

Principal Investigator: T. Davies - EPA

No report.

22. *Remote Measurement of Chlorophyll With Lidar Fluorescent System*

Principal Investigator: H.H. Kim - NASA

No report.

23. *Inflow/Outflow Term - Terrestrial Water Budget*

Principal Investigator: P.L. Cox - U.S. Army Corps of Engineers

Work on the outflow term is completed. The Water Survey of Canada is preparing a report on the inflow term.

24. *Use of an Unsteady-State Flow Model To Compute Continuous Flow*

Principal Investigator: P.L. Cox - U.S. Army Corps of Engineers

Reduction of St. Clair River discharge measurements is about 85 percent complete.

25. *Radiant Power, Temperature, and Water Vapor Profiles Over Lake Ontario*

Principal Investigator: P.M. Kuhn - ERL/NOAA

Work completed.

26. *Algal Nutrient Availability and Limitation in Lake Ontario*

Principal Investigator: G.F. Lee - University of Texas at Dallas

No report.

27. *Wave Studies*

Principal Investigator: P.C. Liu - GLERL/NOAA[2]

No report.

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[2]Affiliation changed to Great Lakes Environmental Research Laboratory (GLERL), NOAA, Ann Arbor, Mich.

28. *Cloud Climatology*

Principal Investigator: W.A. Lyons - University of Wisconsin, Milwaukee

No report.

29. *Zooplankton Production in Lake Ontario as Influenced by Environmental Perturbations*

Principal Investigator: D.C. McNaught - State University of New York at Albany

The final report on this task is being prepared and will be submitted to the EPA Grosse Isle Laboratory.

30. *Change in Lake Storage Term - Terrestrial Water Budget*

Principal Investigator: R. Wilshaw - U.S. Army Corps of Engineers

About 20 percent of the water-level data has been processed.

31. *Soil Moisture*

Principal Investigator: L.T. Schutze - U.S. Army Corps of Engineers

Start on this task continues to be delayed because of lack in manpower and incompleteness of data received from other IFYGL investigators.

32. *Testing of COE (Corps of Engineers) Lake Levels Model*

Principal Investigator: E. Megerian - U.S. Army Corps of Engineers

Task canceled.

33. *Nearshore Study of Eastern Lake Ontario*

Principal Investigator: R.B. Moore - State University of New York at Oswego

The final report on this task is in preparation for submission to the EPA Grosse Isle Laboratory.

34. *Internal Waves - Transects Program - Interpretation of Whole-Basin Oscillations*

Principal Investigator: C.H. Mortimer - University of Wisconsin, Milwaukee

No report.

35. Pontoporeia affinis *and Other Benthos in Lake Ontario*

Principal Investigator: S.C. Mosley - University of Michigan

See IFYGL Bulletin No. 10.

36. *Pan Evaporation Project*

Principal Investigators: C.N. Hoffeditz - NWS/NOAA
J.A.W. McCulloch - AES, Canada

Radiation data from the Canadian stations are in the final stages of reduction. After consistency checks, further analysis will be made. Data from the United States Physical Data Collection System (PDCS) stations have not yet been received.

37. *Simulation Studies and Other Analyses Associated With U.S. Water Movements Projects*

Principal Investigators: J.P. Pandolfo and C.A. Jacobs - CEM

The contractual research on the three-dimensional air-lake interaction model has been completed. The final report, consisting of the following four volumes, is in preparation:

Volume I: "A Description of a General Three-Dimensional Numerical Simulation Model of a Coupled Air-Water and/or Air-Land Boundary Layer."

Volume II: "FORTRAN Program and Input/Output Specifications."

Volume III: "One-Dimensional Model Results."

Volume IV: "Three-Dimensional Model Results."

Some of the results obtained with the one-dimensional model will be presented at the Seventeenth Conference on Great Lakes Research.

A stability analysis was made of several finite difference schemes for representing the coupled equations for the water velocity components and (from the continuity equation) the water surface elevation. A forward implicit scheme was chosen because of its amplification characteristics and because it was the easiest to incorporate into the existing computer program. After the scheme had been programmed into the model, two three-dimensional simulations were made: one with the rigid-lid version of the model for 2 days, and the other with the free-surface version for 1 day. The results of these simulations are being prepared for inclusion in Volume IV of the final report.

38. *Structure of Turbulence*

Principal Investigator: H.A. Panofsky - Pennsylvania State University

A rough draft of the final report is 75 percent complete. It includes discussion of a spectral analysis of buoy data that suggests, but does not prove, the existence of longitudinal rolls. The study of standard deviations of vertical velocity over the lake and over land is not yet finished. The same algebraic expression seems to fit all data, except for a possibly uncertain correction for wave action. Papers on this task will be presented at the Seventeenth Conference on Great Lakes Research in Hamilton, Ontario, in August, and at the AMS/WMO Symposium on Atmospheric Diffusion and Air Pollution in Santa Barbara, Calif., in September 1974.

39. *Airborne Snow Reconnaissance*

Principal Investigator: E.L. Peck - NWS/NOAA

Work continues on the final report.

40. *Optical Properties of Lake Ontario*

Principal Investigator: K.R. Piech - Calspan Corporation

As part of a Skylab experiment, we are doing a study of Lake Ontario and other New York State lakes (Conesus, Honeoye, Canadice, and Chautauqua). Minimum effort has been expended on analyses of IFYGL data, because we felt that current analyses of the Skylab imagery of Lake Ontario would contribute to an understanding of the data collected in 1972 during IFYGL. An interim report has been prepared on these analyses.

Indications are that satellite photography can be used to obtain data on lake turbidity equivalent to those obtained from aircraft imagery. The Skylab data are in general agreement with the IFYGL data, both in terms of level of turbidity and types of lake patterns. The spatial variations on the lake revealed by the Skylab data are of particular interest since they offer insight into the problems of interpolation between IFYGL lake stations and flight tracks.

Additional studies have been made of the consistency and repeatability of the aerial measurements, specifically the ratio values of the blue and green reflectances of the lake. Ratio values of a set of targets obtained from imagery collected at widely differing altitudes on the same day agreed within 12 percent, verifying previous estimates. Similarly, objects whose reflectance characteristics are almost constant temporally (roofs, gravel areas, and concrete and asphalt roadways) were studied based on imagery collected over 1 yr. Variations in the ratio values were again within the 12-percent error estimate, an error limit that also seems to apply to variations in the water quality indices discussed in our earlier reports.

41. *Storage Term - Energy Balance Program*

Principal Investigator: A.P. Pinsak - GLERL/NOAA[3]

No report.

42. *Sensible and Latent Heat Flux*

Principal Investigator: A.P. Pinsak - GLERL/NOAA[3]

No report.

43. *Thermal Characteristics of Lake Ontario and Advection Within the Lake*

Principal Investigator: A.P. Pinsak - GLERL/NOAA[3]

No report.

44. *Oswego Harbor Studies*

Principal Investigator: G.L. Bell - GLERL/NOAA[3]

A revised data tape has been compiled, and a model has been developed to show the percentage of river and harbor water in each of the samples taken in the area of diffusion. A mean percentage based on the results of specific conductance tests from all cruises shows that in samples taken 3 km northeast of the harbor entrance only 10 percent of the water is river and harbor water. A paper on "Diffusion at Oswego Harbor, N.Y." will be presented at the Seventeenth Conference on Great Lakes Research.

45. *Mapping of Standing Water and Terrain Conditions With Remote Sensor Data*

Principal Investigator: F.C. Polcyn - ERIM

Data processing and analysis are complete, and a final report is being prepared.

46. *Remote Sensing Program for the Determination of* Cladophora *Distribution*

Principal Investigators: F.C. Polcyn and C.T. Wezernak - ERIM

A draft of the final report was submitted to the EPA Grosse Isle Laboratory.

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[3]Affiliation changed to Great Lakes Environmental Research Laboratory (GLERL), NOAA, Ann Arbor, Mich.

47. *Remote Sensing Study of Suspended Inputs Into Lake Ontario*

Principal Investigators: F.C. Polcyn and C.T. Wezernak - ERIM

Of the four spectral bands used in ERTS-1 to image the earth's surface, band 4 (0.5 to 0.6 μm) is generally the most useful for observing patterns within Lake Ontario. In this green spectral band, incident solar radiation penetrates to its greatest depths, and suspended materials scatter back some of the radiation. Thus, the synoptic patterns of the lake recorded in band 4 indicate relative turbidity integrated to a depth of several to 10 or more meters; where the turbidity increases, the depth of light penetration decreases. Other ERTS-1 bands, of longer wavelengths, record only phenomena very near the surface, e.g., algae and near-surface suspended materials.

Figure 2 shows the use of image enhancement techniques to provide better discrimination of Lake Ontario water patterns than is apparent in the usual images supplied by NASA. In the case of figure 2, a simple and inexpensive level slice of tape-recorded ERTS-1 data was imaged by a special-purpose high-speed analog processor. Figure 3 is a ratio-enhanced image mosaic of the central portion of the lake for August 20, 1972. Scattered clouds obscure a part of the eastern end of the lake. Note, however, the discrimination of both the nearshore and offshore (current-induced) patterns. Coverage of the lake once every 18 days appears helpful in obtaining information on changing current and suspended material patterns.

Data processing and analyses are complete, and a final report is being prepared.

48. *Island-Land Precipitation Data Analysis*

Principal Investigator: F.H. Quinn - GLERL/NOAA[4]

Data collection is complete, and a report on overland precipitation has been written.

49. *Lake Circulation, Including Internal Waves and Storm Surges*

Principal Investigator: D.B. Rao - University of Wisconsin, Milwaukee

No report.

50. *Atmospheric Water Balance*

Principal Investigator: E.M. Rasmusson - CEDDA/NOAA

The analysis program for fitting continuous functions to the discrete IFYGL rawinsonde data set was made operational. Orthogonal functions and the least-squares criterion are used to choose the coefficients for the functions.

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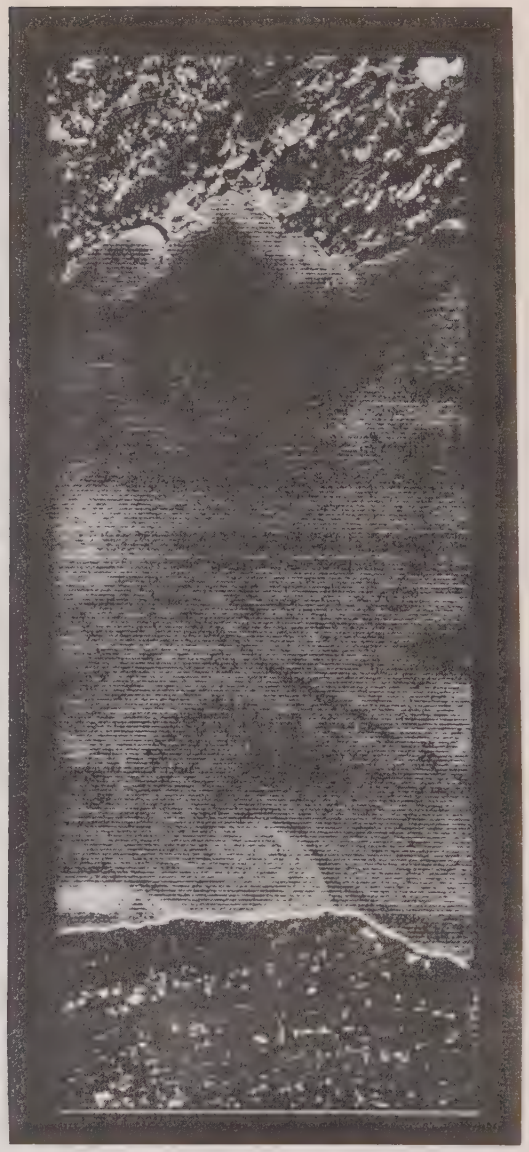
[4] Affiliation changed to Great Lakes Environmental Research Laboratory (GLERL), NOAA, Ann Arbor, Mich.

Original image
(0.5-0.6 μm)



Enhanced image
(level slice)

Figure 2.--ERTS-1 images showing enhancement of water patterns in central Lake Ontario between Braddock Point, N.Y., and Presqu'ile Bay, Ontario, for August 20, 1972. Note particularly coastline areas of low and high turbidity and the Archimedes spiral off Braddock Point.

Figure 3.--Enhanced ERTS-1 mosaic showing near-surface patterns in central Lake Ontario, August 20, 1972.

Time-height cross sections of the fitted quantities u, v, and q have been generated and compared with cross sections of the original data. These comparisons indicate that further engineering of the analysis scheme is required before useful budget results can be obtained. The subroutine for integrating and/or differentiating the fitted functions was also completed.

Work during the next quarter will center on refinement of the analysis scheme, and on heat and budget computations for the 6-day period from October 30 to November 4, 1972. A background paper on the project will be presented at the Seventeenth Conference on Great Lakes Research.

51. *Evaporation Synthesis*

Principal Investigator: F.H. Quinn - GLERL/NOAA[5]

First-cut evaporation data are being compared and analyzed.

52. *Groundwater Flux and Storage*

Principal Investigator: E.C. Rhodehamel - U.S. Geological Survey

Task completed.

53. *Spring Algal Bloom*

Principal Investigator: A. Robertson - GLERL/NOAA[5]

Analysis awaits availability of data.

54. *Ice Studies for Storage Term - Energy Balance*

Principal Investigator: F.H. Quinn - GLERL/NOAA[5]

Data report completed.

55. *Lagrangian Current Observations*

Principal Investigator: J.H. Saylor - GLERL/NOAA[5]

No report.

56. *Circulation of Lake Ontario*

Principal Investigator: J.H. Saylor - GLERL/NOAA[5]

No report.

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[5]Affiliation changed to Great Lakes Environmental Research Laboratory (GLERL), NOAA, Ann Arbor, Mich.

57. *Phytoplankton Nutrient Bioassays in the Great Lakes*

Principal Investigator: C. Schelske - University of Michigan

Task not activated.

58. *Runoff Term of Terrestrial Water Budget*

Principal Investigator: G.K. Schultz - U.S. Geological Survey

Work on this task is complete.

59. *Coastal Chain Program*

Principal Investigator: J.T. Scott - State University of New York at Albany

Our computer program has been modified to subdivide line transports into various components. For all three United States coastal chains the following have been calculated:

(a) Daily positive and negative longshore transport (U) above and below the thermocline.

(b) Daily positive and negative baroclinic geostrophic transport (UG) above and below the thermocline.

(c) Daily positive and negative (U-UG) transport above and below the thermocline.

(d) Daily positive and negative U, UG, U-UG transport inside and outside jet cores.

The Canadian coastal chain data are now being used for similar computations. Some of the above data will be presented by Scott and Landsberg in a paper on "Coastal Transport Processes in Lake Ontario" at the Seventeenth Conference on Great Lakes Research.

Calculations have also been made of the following: (a) daily heat transport across the coastal chains; (b) daily total velocity kinetic energy; (c) daily longshore velocity component kinetic energy; (d) daily baroclinic velocity kinetic energy; and (e) daily U-UG kinetic energy.

60. *Analysis of Phytoplankton Composition and Abundance*

Principal Investigator: E.F. Stoermer - University of Michigan

The final report on this task has been submitted to the EPA Grosse Isle Laboratory.

61. *Clouds, Ice, and Surface Temperature*

Principal Investigator: A.E. Strong - NESS/NOAA

See IFYGL Bulletin No. 11.

62. *Analysis and Model of the Impact of Discharges From the Niagara and Genesee Rivers on Nearshore Biology and Chemistry*

Principal Investigator: R.A. Sweeney - State University of New York at Buffalo

The final report is being prepared and will be submitted to the EPA Grosse Isle Laboratory.

63. *NCAR/DRI - Buffalo Program*

Principal Investigator: J.W. Telford - Desert Research Institute, University of Nevada

The vertical component of air motion and humidity (mixing ratio) has been analyzed, and the heat and moisture fluxes over the lake are being calculated. In addition, the horizontal wind data are being replotted to reexamine air mass modification over the lake. Two straight, level runs across the lake that show frequent changes in wind magnitude and direction are being replotted simultaneously with temperature and moisture to extract possible correlations.

A paper describing some of the results obtained so far will be presented at the Seventeenth Conference on Great Lakes Research, and Part I of another paper dealing with instrumentation and sensor accuracies, and containing some illustrative analyzed data, has been submitted to the Journal of the Atmospheric Sciences.

64. *Mathematical Modeling of Eutrophication of Large Lakes*

Principal Investigator: R.V. Thomann - Manhattan College

Work continued on refining the three-segment LAKE 1 model. To determine the time to dynamic steady state, under a configuration consisting of a constant nutrient loading scheme, a run for a 16-yr period was made on this model. Lake Ontario has a hydraulic retention time of 7.9 yr. For the spatially simplified LAKE 1 model, dynamic steady state was reached in about 10 yr. The Niagara and tributary inflow and the St. Lawrence outflow were set as constants.

The spatially defined LAKE 3 model, which contains 67 segments within 5 vertical layers, was run with the biological and chemical submodels refined in the work on LAKE 1. The results of these preliminary runs are being analyzed.

Work on the LAKE 2 model, which consists of seven completely mixed layers for spatial definition, is centered mainly on the chemical submodel, with special emphasis on the carbonate system.

65. Cladophora *Nutrient Bioassay*

Principal Investigator: G.F. Lee - University of Texas - Dallas

Inactive.

66. *Sediment Oxygen Demand*

Principal Investigator: N.A. Thomas - EPA

Chemical processing of all the benthic samples has been completed, and a final report is being prepared. The highest sediment oxygen demands were noted in the eastern end of Lake Ontario. The average sediment oxygen demand for the lake is illustrated in figure 4.

67. *Main Lake Macrobenthos*

Principal Investigator: N.A. Thomas - EPA

All benthic organisms have been identified, analysis is complete, and a final report describing the distribution of the various benthic species has been submitted for inclusion in the Proceedings of the Seventeenth Conference on Great Lakes Research.

68. *Exploration of Halogenated Hazardous Chemicals in Lake Ontario*

Principal Investigators: G.F. Lee - University of Texas at Dallas
C.L. Haile - University of Wisconsin

No report.

69. *Basin Precipitation - Land and Lake*

Principal Investigator: J.W. Wilson - CEM

Substantial progress was made in planning, developing, and checking out the computer program to combine the radar and rain-gage data into one analysis. The procedure consists of the following steps:

(1) An objective analysis is applied to daily precipitation totals measured by the gages. A grid, with intervals of 3.5 mi, covering the watershed and the lake is used for the analysis.

(2) The daily precipitation as measured by radar within a 2-mi radius of the gage and the rainfall as estimated by radar at each of 3.5-mi grid squares are determined. The radar data have been range adjusted

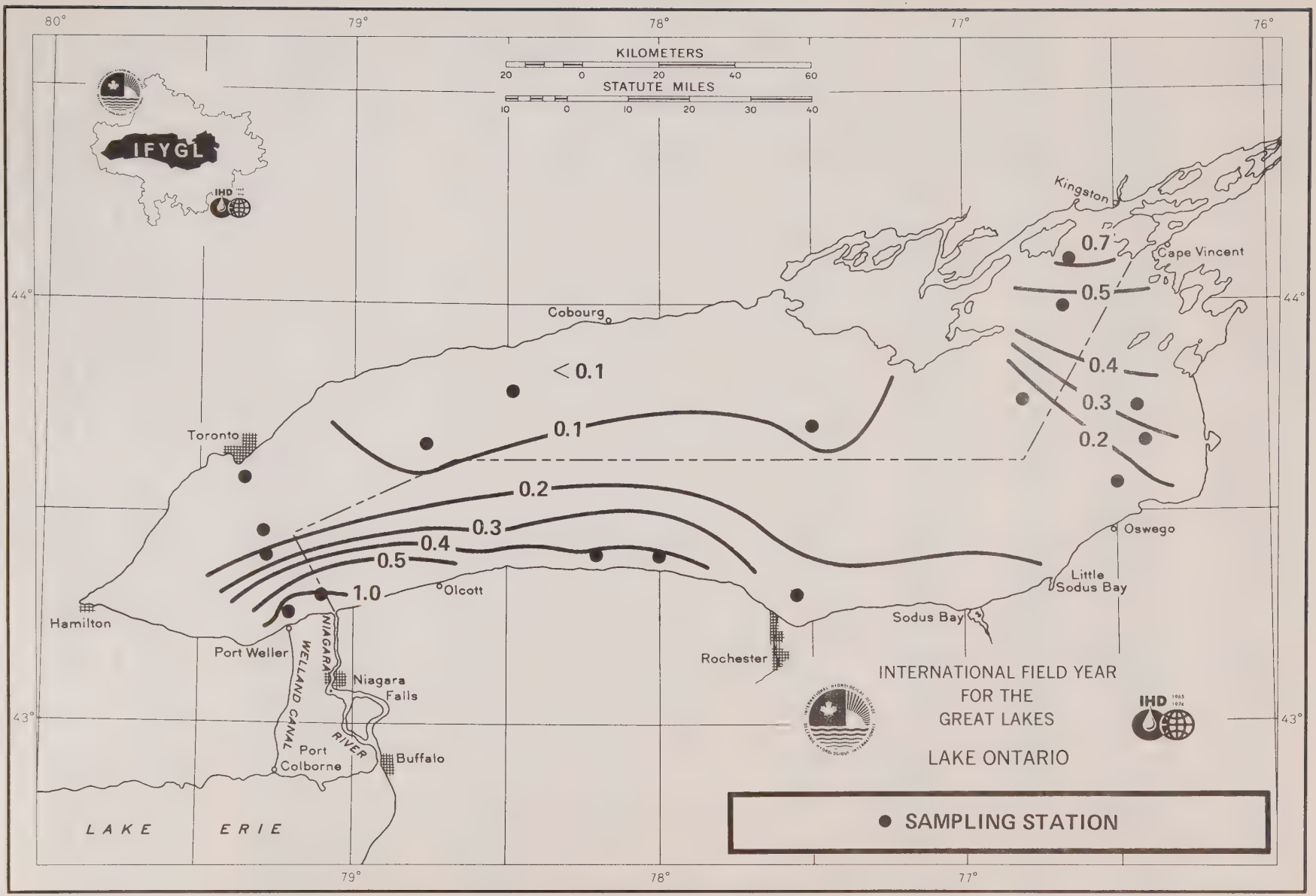

Figure 4.--Lake Ontario sediment oxygen demand rate (g $O_2/m^2/day$), July-August, 1972.

with empirically derived corrections that vary with precipitation type and height of the freezing level. Ground clutter and azimuths at which the radar beam is blocked by terrain features have been edited.

(3) The ratio between the precipitation measured at each gage site by radar and by gage is determined, and an objective analysis is then made of the field of gage/radar ratios to obtain a field of adjustment factors for the radar data.

(4) The precipitation amount determined in step (2) are multiplied by the radar adjustment field from step (3) to obtain a corrected radar analysis.

(5) The corrected radar analysis obtained in step (4) is combined with the gage analysis from step (1) to obtain the final precipitation analysis.

All rain-gage data from Canada and the United States were placed on magnetic tape. Production runs of the gage analysis, discussed under step (1) above, are almost complete, and watershed and lake precipitation totals have been obtained. The watershed totals agree closely with those derived by F.H. Quinn.

The daily precipitation estimates for step (2) were derived from the Oswego radar, and production runs on the Oswego data are in progress. The film of the Buffalo radar PPI scope was examined to determine to what extent data collected on magnetic tape for each day covered the precipitation events within the watershed. With this information, it is now possible to identify those days for which the Buffalo radar data can be used to estimate watershed precipitation. Plans were to complete derivation of preliminary daily precipitation totals for Lake Ontario during this reporting period; however, since the remaining days were in the winter, when it was often difficult to detect snow by radar at distant ranges, these plans were abandoned until the gage data can be used to compensate for the detection problems.

70. *Evaluation of ERTS Data for Certain Hydrological Uses*

Principal Investigators: D.R. Wiesnet and D.F. McGinnis - NESS/NOAA

Difficulty in obtaining ground-truth data has hampered efforts to complete the evaluation of snow-extent mapping of the entire Lake Ontario basin. In addition to the one map for February 13, 1973, four other maps of snow extent have now been prepared: for March 8 and 28, 1973, and March 14 and 18, 1974.

Because of damage during shipping, the color densitometer had to be sent to the manufacturer for repair. With its return at the end of June, the soil moisture study will resume in the next quarter. Attempts have been made to identify soil types and soil moisture by experimenting with the color additive viewer and three combinations of multispectral imagery, including

positive and negative transparencies. Preliminary results of analysis of the dual-channel thermal IR data indicate possible correlations between soil moisture and the earth's radiant temperature.

71. *Distribution, Abundance, and Composition of Invertebrate Fish Forage Mechanisms in Lake Ontario*

Principal Investigator: J.H. Kutkuhn - Great Lakes Fisheries Laboratory

An abstract was prepared of a paper on "Food of Rainbow Smelt and Alewives in Lake Ontario, 1972" to be presented at the Seventeenth Conference on Great Lakes Research.

72. *Coastal Circulation in the Great Lakes*

Principal Investigator: G.T. Csanady - Woods Hole Oceanographic Institution

No report.

73. *Lake Water Characteristics*

Principal Investigator: A.P. Pinsak - GLERL/NOAA[6]

No report.

74. *Snow Observation Network*

Principal Investigator: Robert B. Sykes, Jr. - State University of New York at Oswego

The snow observation network east of Oswego was closed down in the middle of March. Data were collected by observers on snow depths, water equivalents, and snow crystal types at 35 locations, and by mobile units along transects. Eight snow gages were in operation from mid-November to mid-March 1974.

Work during the quarter consisted of extracting snow amounts from the gage traces, evaluating and summarizing the observer reports, developing designations for snowfall situations, and developing and cataloging photographs. Results of some analyses indicate that snow crystals and snowflakes tend to be larger near the lakeshore than further inland during lake effect situations, and that snow crystal types are quite variable during such situations. Variation is less during colder periods than toward the end of the season when temperatures also vary in the vertical.

A final report is being drafted, and a paper is being prepared for presentation at the Seventeenth Conference on Great Lakes Research.

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[6] Affiliation changed to Great Lakes Environmental Research Laboratory (GLERL), NOAA, Ann Arbor, Mich.

75. *Lake Circulation Model*

Principal Investigator: J.R. Bennett - MIT[7]

A publication dealing with a simulation of Lake Ontario circulation in July 1972 is being prepared. A paper on verification of the mean circulation will be presented at the Seventeenth Conference on Great Lakes Research, and a paper on this verification and on the response of the Great Lakes to storms is also in preparation.

76. *Lake Ontario Invertebrate Fauna List*

Principal Investigator: A. Robertson - GLERL/NOAA[8]

The faunal list has been generated, and work has been done on summarizing the distribution of the various forms within the lake.

77. *Distribution and Variability of Physical Lake Properties*

Principal Investigator: R. Pickett - GLERL/NOAA[9]

Monthly mean air and water temperatures, winds, and currents were calculated for Lake Ontario from the July 1972 buoy and tower data. The mean air temperature pattern was similar to that of the lake surface temperature except in the northwestern part of the lake due to the warm air around Toronto. Surface water temperatures showed warm water (>19°C) along the south-central shore and a cold pocket (16°C) in the northwest. A subsurface cold pocket was also found in midlake. Perturbations of the mean temperature field were maximum near the surface and thermocline at the lowest frequencies (< 0.02 cycles hr^{-1}). The diurnal temperature signal was significant near the surface, and the inertial signal was significant near the thermocline. Winds were from the west at about 3 m s^{-1}. In response, the thermocline tilted from 5 m along the northwestern shore to 14 m along the southern shore of the lake. Monthly currents indicate cyclonic flow at all depths, and a shortcut north of Rochester along the midlake ridge. The observed currents were consistent with geostrophic calculations. Current perturbations were maximum near the surface at the lowest frequencies and at the inertial frequency.

The above results will be presented at the Seventeenth Conference on Great Lakes Research.

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[7]Affiliation changed to Massachusetts Institute of Technology.

[8]Affiliation changed to Great Lakes Environmental Research Laboratory, (GLERL), NOAA, Ann Arbor, Mich.

[9]E. Aubert and J. Harrison are no longer associated with this task.

78. *Carbon Cycle Model*

Principal Investigators: A. Robertson and B. Eadie - GLERL/NOAA[10]

A monthly carbon budget for the Field Year has been produced to identify the importance of the various sources and sinks of carbon. Major sources were found to be inorganic carbon from tributary streams, especially the Niagara, and the organic matter produced in primary productivity. The major sinks included inorganic outflow at the St. Lawrence and net CO_2 gas exchange with the atmosphere. Inflow and outflow of river organic matter, sedimentation of organic and inorganic matter, groundwater transport, and municipal and industrial perturbations accounted in total for less than 10 percent of the carbon movement.

The lake has an inventory of approximately 4.0×10^{10} kg of inorganic carbon and approximately an order of magnitude less organic carbon. The river-borne flux of inorganic carbon at 0.5×10^{10} represents 13 percent of the lake's inventory, and, under the assumption of complete mixing, a minimum mean residence time of 8 yr. The lake's inorganic carbon system appears to have been stable over the past 60 yr.

The seasonal cycle inherent in the fixation of carbon in primary productivity is balanced primarily by a complementary seasonal cycle in the air-lake CO_2 gas exchange system. The lake acts as a sink for CO_2 gas in the warm months, when primary productivity is highest, and as a source of CO_2 in the colder part of the year.

The higher flow rates during IFYGL do not appear to have perturbed the inorganic system. Comparison of IFYGL calculations with corresponding terms calculated from data for an "average year", created from historical data, shows no major difference.

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[10]Affiliation changed to Great Lakes Environmental Research Laboratory (GLERL), NOAA, Ann Arbor, Mich.

Panel Reports

Biology and Chemistry - N.A. Thomas, U.S. Panel Cochairman

Most of the U.S. reports on biological and chemical studies are in preparation. Data of various types are now becoming available, which should enhance the prospect of completion of these reports.

Boundary Layer - J.Z. Holland, U.S. Panel Cochairman

A summary of the Boundary Layer Panel's results was presented at the IFYGL Symposium at the American Geophysical Union meeting on April 8. The paper covered results of analyses by individual investigators and included a status report on these analyses.

A panel meeting has been scheduled for August 12, 1974, at McMaster University, Hamilton, Ontario.

Terrestrial Water Balance - B.G. DeCooke, U.S. Panel Cochairman

A draft outline of the Terrestrial Water Balance final report has been reviewed by the principal investigators, and copies of the revised outline have been submitted to the IFYGL Steering Committee and the Joint Management Team for approval. Plans are to begin writing the first draft of the report in October.

DATA MANAGEMENT

Data Processing

The status of the data processing done at the Center for Experiment Design and Data Analysis (CEDDA) is given below. As the data sets are completed, they will be available from the National Climatic Center (NCC), the depository for the IFYGL Permanent Archive.

Ship System

Processing is on schedule. As of August 31, 1974, data from 10 of the 56 ship cruises had been run through the final edit, and 6-min averages have been generated.

Physical Data Collection System (PDCS)

All the subtasks for generating the Provisional Data Base, as shown in table 1, have been completed. The data set consists of data merged from all PDCS sources, with valid calibrations applied. No editing has been done, and gross errors may be present. The data are available on seven-track, 800 BPI, BCD tapes; microfilm displays of the individual 6-min observations and time-series graphics are also available. Copies of the magnetic tapes and microfilm have been forwarded to both NCC and CCIW. Work is proceeding on the editing and production of hourly averages.

Rawinsonde Data Processing

Final processing of the rawinsonde data is complete, and the data are available from NCC. Sets have been generated for 5-s intervals, 10-mb surfaces, and 50-mb surfaces. The following is a summary of soundings involved:

Rawinsonde soundings	Number
Total scheduled releases	3,054
Total actual releases	2,953
Total processable soundings	2,823
Total manually processed soundings	210
Total soundings over 400 mb	2,423

IFYGL Archive

In IFYGL Bulletin No. 11, a summary was given in tables 8 and 9 (pp. 88-104) of the status of data sets to be included in the IFYGL Permanent Archive. Supplementary information on U.S. data sets received since that time is given in table 2.

Table 1.--PDCS Data Base

Task	Monthly Data Increment										
	July	Oct.	May	June	Aug.	Sept.	Nov.	Dec.	Jan.	Feb.	Mar.
1. Preliminary workup (CEDDA)	x	x	x	x	x	x	x	x	x	x	x
2. Automatic processing (LSC)	x	x	x	x	x	x	x	x	x	x	x
3. Verify automatic RCC processing (CEDDA)	x	x	x	x	x	x	x	x	x	x	x
4. Manual RCC processing (CEDDA)	x	x	x	x	x	x	x	x	x	x	x
5. Generate cassette parameters (CEDDA)	x	x	x	x	x	x	x	NA	NA	x	x
6. Automatic cassette processing (LSC)	x	x	x	x	x	x	x	NA	NA	x	x
7. Manual cassette processing (CEDDA)	x	x	x	x	x	x	x	NA	NA	x	x
8. Merge all data (LSC)	x	x	x	x	x	x	x	x	x	x	x
9. Generate graphics, perform analysis (CEDDA)	x	x	x	x	x	x	x	x	x	x	x
10. Preliminary workup prior editing (CEDDA)	x	x	x	x	x	x	x	x	x	x	x
11. Manual entries for editing (CEDDA)	x	x	x	x	x	x	x	x	x	x	x
12. Perform automatic edit (CEDDA)	x	x	x	x	x			x			
13. Produce hourly averages (CEDDA)											
14. Generate edited graphics (CEDDA)											
15. Archive PDCS data (CEDDA, NCC)											

x = Completed as of July 31, 1974.

Note: Items 1 - 9 are required for generating the Provisional PDCS Data Base, items 10 - 15 for the final, edited PDCS Data Base.

Table 2.--Summary of data for final IFYGL Archive: United States

TASK NO.	INVESTIGATOR		DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
			ATMOSPHERIC BOUNDARY LAYER				
3	Bean		RFF/DC-6 (Gust Probe)				
		3.	Reduced turbulence data.	Mag. tape	At NCC	Y	In archive
		4.	Computed flux spectra, time-series spectra.	Microfilm	At NCC	Y	In archive
		5.	Time series graphics (u,v,w,T,ρ_w).	Microfilm	At NCC	Y	In archive
		6.	Means, variances, and fluxes.	Pages	At NCC	Y	In archive
5	Businger		Profile Mast and Tower				
		3.	Edited meteorological (Cobourg) time series 4/s.	Mag. tape	Jan. '75	N	
14	Estoque		Boundary Layer Structure				
		6.	Processed meteorological data - listing.	Microfilm	Now	PI	
		10.	BLIP Logs.	Pages	Sept. '74	Y	
63	Telford		NCAR/DRI Aircraft				
		6.	Open literature reports.	Pages		Y	
12			BIOLOGY - CHEMISTRY				
12	Bonnham-Carter		Rochester Embayment Study				
35	Mosley	1.	Benthos study.				
		3.	Water temperature - *Kaho, Limnos*			?	
60	Stoermer	1.	Phytoplankton				
		3.	Data count - pre-report.	Pages	At NCC	Y	Apr.-July '74
73	Pinsak		Lake Water Characteristics				
		1.	Edited depth, temperature, chemical composition data.	Mag. tape	At NCC At CCIW	Y	In archive
		2.	Final report.	Pages	At NCC	Y	In archive
			ENERGY BALANCE				
17	Pavlak		Nearshore Ice Formation				
		5.	Data report.	Paper	At NCC	Y	In archive
100	CEDDA		PHYSICAL DATA COLLECTION SYSTEM (PDCS)				
		1.	Basic data base - in engineering counts.	Mag. tape	Part at NCC	T	
		2.	Provisional meteorological and limnological data (6 min).	Mag. tape	Part at NCC	Y	
		3.	" " data listing.	Microfilm	Part at NCC	Y	
		4.	" " time-series graphics.	Microfilm	Part at NCC	Y	
		11.	Analyst's technical manual and system field documentation.	Microfilm	At NCC	Y	In archive
101	CEDDA		U.S. IFYGL SHIP SYSTEM - *Researcher*				
		11.	9-point digitized EBT.	Punched cards	At NCC	Y	In archive
		16.	Dissolved oxygen traces.	Microfilm	At NCC	Y	In archive
		17.	Barograph charts.	Charts		Y	

Table 2.--Summary of data for final IFYGL Archive: United States (cont'd)

TASK NO.	INVESTIGATOR	DESCRIPTION OF DATA	MEDIA	DATE AVAILABLE FROM INVESTIGATOR	ARCHIVE	DATE TO ARCHIVE
102	CEDDA	U.S. IFYGL SHIP SYSTEM - *Advance II*				
	9.	Manual observations - edited.	Mag. tape	At NCC	Y	In archive
103	CEDDA	Rawinsonde.				
	6.	Final data,10 mb.	Mag. tape	At NCC	Y	In archive
	7.	Final data,50 mb.	Mag. tape	At NCC	Y	In archive
	12.	Prefinal (5 s, 10 mb, 50 mb).	Mag. tape	At NCC	Y	In archive
118	IFYGL	MISCELLANEOUS REPORTS FOR IFYGL				
	1.	Technical Plan.				
	2.	Bulletin.				
	3.	Technical Manual Series				
	4.	Scientific Series				
		TERRESTRIAL WATER BALANCE				
30	Wilshaw	Lake Water Level Gages - U.S.				
	4.	Edited (converted to common datum). Hourly water levels.	Mag. tape	At NCC	Y	In archive
45	Polcyn	Remote Sensing				
	2.	Aerial color photography. (transparencies?)	70-mm film	Now	PI	
	3.	Black and white 9 in.	Prints	Now	PI	
	4.	" " "	Film neg.	Now	PI	
	6.	Final report.	Pages	June '74	Y	June-July '74
	7.	Aircraft flight data records.	Pages	At NCC	Y	In archive
58	Schultz	Runoff				
	4.	Weekly data.	Cards	At NCC	Y	In archive
	5.	Weekly data.	Page	At NCC	Y	In archive
70	Weisnet/McGinnis	Aerial Hydrological Survey				
	1.	NASA U2 photography - 6 overflights.	70-mm film	2 reels at NCC	N	In archive
74	Sykes	Snow Observation Network				
	6.	Oswego area weather radar project 1972/73	Pages	At NCC	Y	In archive

Y = Yes. The original or suitable copy will be placed in the archive.

N = No. Data will not be placed in the archive.

PI = The Principal Investigator or his organization will retain the data. If decision is made to release data later, NCC will accept them either for temporary storage or permanent retention, as specified in each case.

? = Data are being considered for placement in the archive.

T = Temporary retention as specified for original data in the IFYGL Technical Plan.

FROM THE DESK OF THE U.S. IFYGL COORDINATOR

The request stated in Bulletin No. 11 for submission of eight copies of all IFYGL related publications to the U.S. IFYGL Data Center is rescinded.

In place of the above it is requested that all participants provide the U.S. IFYGL Project Office with a list of all their IFYGL-related publications for a bibliography to be included in future Bulletins. Also, up to 20 copies of each publication should be sent to the Project Office addressed to:

C.F. Jenkins
Great Lakes Environmental
Research Laboratory, NOAA
2300 Washtenaw Avenue
Ann Arbor, Mich. 48104

U.S. PUBLICATIONS ON IFYGL

Bennett, J.R., "On the Dynamics of Wind-Driven Lake Current," Journal of Physical Oceanography, 1974, Vol. 4, No. 3, pp. 400-414.

Csanady, G.T., "The Roughness of the Sea Surface in Light Winds," Journal of Geophysical Research, 1974, Vol. 79, No. 18, pp. 2747-2751.

Csanady, G.T., "Equilibrium Theory of The Planetary Boundary Layer With an Inversion Lid," Boundary Layer Meteorology, 1974, Vol. 6, Nos. 1/2, pp. 63-69.

Lyons, W.A., and S.R. Pease, "A Year-Round All-Sky Time-Lapse Camera System For Mesoscale Cloud Mapping," Proceedings of the 15th Conference on Great Lakes Research, International Association for Great Lakes Research, 1972, pp. 507-520.